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A CONTRIBUTION TO THE SYSTEMATICS OF THE MARINE TUBIFICIDAE (ANNELIDA, OLIGOCHAETA)

R. O. BRINKHURST

*Department of Zoology, The University of Liverpool*¹

The brackish-water and marine species of Tubificidae were listed in an earlier publication (Brinkhurst, 1963a), but since then some new species have been described from North America (Brinkhurst, 1965; Brinkhurst and Gitay, in press). More recently, the acquisition of material from the Bahamas, Florida, and North Carolina has made possible the re-description of a species originally described by Pierantoni (1902, 1916) from Naples. Amongst the same collections were specimens of a new marine enchytraeid (to be described elsewhere by Dr. C. R. Kennedy), and specimens of a new tubificid. Material from brackish-water sites in Alaska is also to hand, but will be used as a basis for a separate revision of the genus *Monopylephorus* Levinsen.

The various species described by Pierantoni (1902, 1904, 1916) have seldom, if ever, been reported by subsequent workers. In an attempt to trace material of these poorly-known species, I visited Naples in 1964. A careful search of mud-samples from the type localities failed to produce any new material, and the types were not found in the Marine Biology Station. The types may be in the museum of the University of Naples, but no response to appeals for material has been received. It was a considerable surprise to find material of what was clearly recognizable as *Heterodrilus arenicolus* Pierantoni among collections sent to me by Dr. Meredith Jones (The Smithsonian Institution), and Dr. J. H. Day (Duke University Marine Laboratory, Beaufort, North Carolina, and The University of Cape Town.)

Examination of whole-mounts, dissections, and sections made it clear that North American specimens shared some of the characters of *H. arenicolus* and *Clitellio subtilis* Pierantoni. Pierantoni (1916, p. 90) expressed the view that the differences in the genitalia which served to place these two entities in separate genera were, perhaps, misleading, in view of the close similarity of the rest of their anatomy. The discovery of spermathecae in my specimens, together with the re-description of the male efferent ducts of both this and *Clitellio arenarius* (Müller), make the retention of the genus *Heterodrilus* invalid. The genus *Limno-*

¹ Present address: Ramsay Wright Zoological Laboratories, University of Toronto, Toronto 5, Ontario, Canada.

driloides has already been merged with *Clitellio* (Brinkhurst, 1963b), and the new material shows some relationship to species formerly in that genus. The genus *Clitellio* may now be defined as follows:

Clitellio Savigny, 1820

Male efferent ducts tubular, prostate glands present or absent; when present, attached to atria by a broad base. Pseudo-penes or penes present. Spermathecae present, with spermatophores. No coelomocytes. All species thus far described lack hair setae and pectinate setae, and occupy brackish or salt-water habitats.

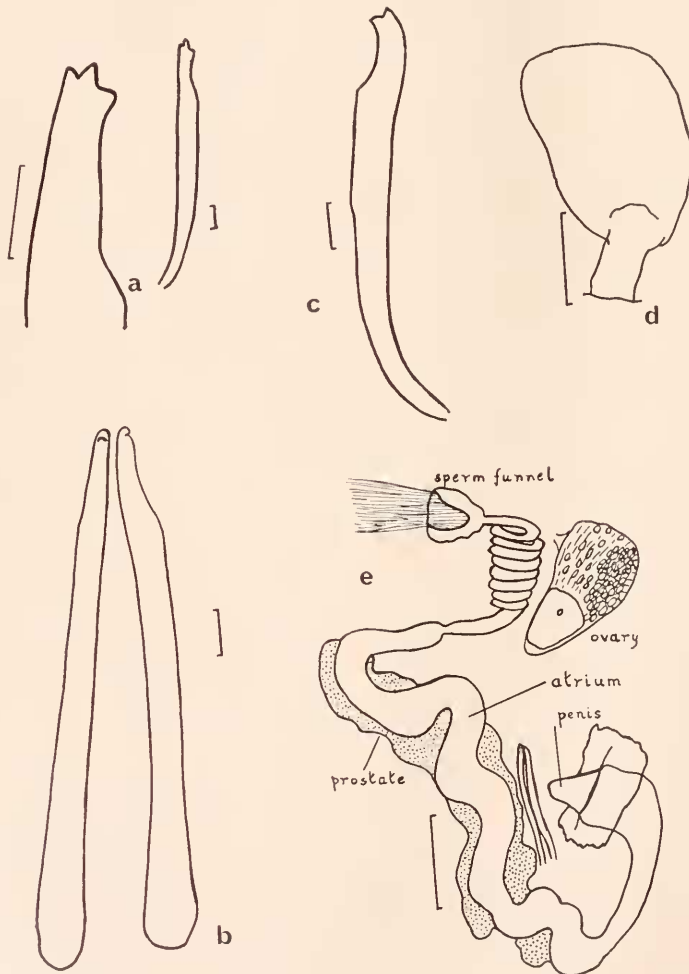


FIGURE 1. a, anterior trifid setae; b, penial setae; c, posterior bifid seta; d, spermatheca; e, male efferent ducts, showing coiled vas deferens, diffuse prostate, pseudo-penis, penial setae. An ovary is shown close to the coiled vas deferens. Scales a, b, c = 0.01 mm., d, e = 0.1 mm.

Type species: *Clitellio arenarius* (Müller, 1776)

The true nature of the male efferent ducts was not appreciated when the preliminary review of the Tubificidae was drawn up (Brinkhurst, 1963b). Subsequent examination of dissections and whole-mounts of *Clitellio arenarius* proved that the division of the atrium into two lobes is more apparent than real. The male ducts have to occupy part of the sperm-sac, owing to their length, and the atrium is constricted at the point at which it passes through Septum 11/12. The atrium is thin-walled, and there is no prostate gland.

The definition of the genus was revised later (Brinkhurst, 1965) when it was noted that no species thus far described had genital setae. The statement was carefully worded to indicate that the discovery of a species that appeared to fit the definition in all other respects would not be excluded from *Clitellio* simply by the possession of genital setae. The revised definition stated that pseudo-penes were present in the genus. Michaelsen (1908, 1914) claimed that true penes were present in *C. arenarius* and in *C. winckelmanni*. Pierantoni (1904, 1916) described penes in *Limnodriloides*, *Heterodrilus* and *Clitellio* species, some of which appear more like pseudo-penes in the illustrations. Examinations of sections of *C. arenarius* show that there are, in fact, very simple penes in the penis-sacs. The distinction between eversible pseudo-penes, protrusible pseudo-penes and penes, has been discussed elsewhere (Brinkhurst, 1966), where it was shown that in eversible pseudo-penes the muscular layer of the atrial wall became modified into two layers joined by fibers running across a space formed between the layers. This would allow the lining cells of the atrium to be protruded through the muscle layer, the protrusion being completed by the eversion of the in-tucked pouch of the body-wall which forms the penis sac when the penis is present. The true penis is then defined as the permanent lobe lying in this sac, penetrated by the thin distal end of the atrium. The penes of *C. arenarius* are of the simplest possible type, with the split developed in the muscular layer of the atrium, but there is also a small lobe of the penis-sac which looks as though it is permanent once formed. The true anatomical male pore is thus at the end of this small penis, and not at the summit of the eversible penis-sac. In *H. arenicolus* there do not seem to be any true penes, but the separation of the lining layer and muscular layer of the terminal part of the atrium is well-developed.

Clitellio arenicolus (Pierantoni, 1902)

Heterodrilus arenicolus Pierantoni, 1902, pp. 115–117, fig. 3; 1916, pp. 87–90, Pl. 4, fig. 6–11; Brinkhurst, 1963a, pp. 714; 1963b, pp. 74.

Length 0.75–1 cm., 45–60 segments. Prostomium elongate, conical. Anterior end of worm markedly narrow. Setae in four bundles per segment from segment II. Setae of segments II–IX, two per bundle blunt-ended or trifid (Fig. 1a). A single unmodified setae in each bundle of X, ventral bundles of XI each with two blunt penial setae each (Fig. 1b). Post-clitellar setae single, with short teeth, the upper tooth usually the shorter, or even rudimentary (Fig. 1c). Spermathecal pores in line with and posterior to the ventral setae of XI. Female pores in line of ventral setae in 10/11, spermathecae in X (Fig. 1d). Male ducts with coiled vas

deferens, tubular atrium with prostate gland (Fig. 1e). Ejaculatory duct narrow, protrusible pseudo-penes. Spermatophores formed. No coelomocytes.

U. S. National Museum Collection: 33004, 0.5 km. N. entrance point, W. side N. Bimini (25°43'2"N, 79°19'0"W), August 27, 1962; 33009 off-shore Panama City, Florida (30°03'6"N, 86°08'8"W), April 8, 1958. Four slides. Coll. M. L. Jones.

J. F. Day Collection: Beaufort Shelf transect, off North Carolina.

34°36'5"N, 76°30'0"W, 5 m., depth, April 19, 1965;

34°34'5"N, 76°25'5"W, 20 m., April 19, 1965;

34°19'6"N, 75°56'8"W, 130 m., April 6, 1965 (12 specimens)

The male efferent ducts and spermathecae are almost exactly the same as those described for *C. subtilis* by Pierantoni (1916). The only exception is the presence of a prostate gland. This gland envelops most of the atrium, but does not appear to be a simple diffuse cellular layer of the form found in *Bothrioneurum*, *Monopylephorus*, *Rhyacodrilus*, and others. On the other hand, no distinct point of entry into the atrium could be discerned, so that the prostate does not appear to be of the bulky type found in the genera *Tubificx*, *Limnodrilus* and many others. It is just possible that it is intermediate in nature, being lobed but rather broadly attached to the atrium as in *C. appendiculatus* (Boldt, 1928), but this was impossible to discern on either the sections or dissections.

The tridentate anterior setae are identical to those described and figured for *H. arenicolus* by Pierantoni (*loc. cit.*). The penial setae are not smaller than the others (as in *H. arenicolus*, according to Pierantoni), but are larger, as in most tubificids with genital setae. The explanation of this apparent confusion may be attributable to faulty interpretation of poor sections in the original account, or simply to incomplete maturation of the male ducts in the Italian specimens. The absence of spermathecae in some specimens of otherwise normal species has already been noted as a rare variation in tubificid systematics. I conclude that *C. subtilis* is likely to prove to be no more than a variety of *C. arenicolus*, but the discovery of fresh material for comparison with forms bearing trifid setae must precede a final decision on the matter.

The second species to be described is attributed to a new genus. A single dissection revealed a unique type of male efferent duct, and this was subsequently confirmed by sections of a specimen which had previously been examined in Amman's lactophenol, a process which did not improve the quality of the material.

SMITHSONIDRILUS nov. gen.

Male efferent ducts tubular, opening into a common chamber in association with two paratria. Prostate glands cap the paratria. Spermathecae present, with spermatophores. No coelomocytes.

Type species: *Smithsonidrilus marinus* nov. sp.

Smithsonidrilus marinus nov. sp.

Length 10–15 mm. × 0.75 mm. 40–70 segments. Worm wound in a thin coil with long narrow segments. Prostomium short and blunt. Pharynx eversible.

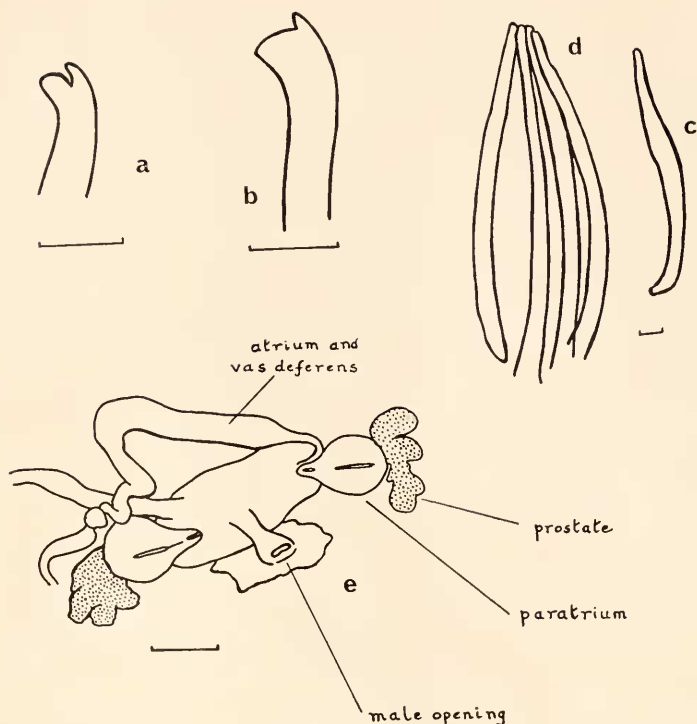


FIGURE 2. a, anterior seta; b, posterior seta; c, spermathecal seta; d, penial setae; e, male efferent ducts, showing median chamber with single median superficial male pore, two paratria with prostates, two vasa deferentia (incomplete). Scales a, b, c, d = 0.01 mm., e = 0.1 mm.

Setae all bifid crotchets, those of the anterior bundles 2–5 in number, with the upper tooth shorter and thinner than the lower (Fig. 2a), falling to 1–2 per bundle with even shorter upper teeth posteriorly, the lower tooth being exceptionally broad (Fig. 2b). Spermathecal setae blunt, 3–4 on each side (Fig. 2d). Vas deferens and/or atrium (scarcely distinguishable) short and thin, no prostates present on the atria. These ducts open near the base of the paratria, which project into a median chamber with a midventral superficial male pore (Fig. 2e). Paratria bear prostates. Spermathecae with spermatophores 10–15 times longer than broad.

U. S. National Museum Collection: Holotype 32967, Tampa Bay, Florida, 27°51'4"N, 83°35'4" W, 27°51'3"N, 83°33'2"W, January 29, 1959; Paratypes 32968–71, Panama City, Florida, April 8, 1958; Pt. Boca, Ciega Bay, Florida, January 29, 1959; S. side Tavenier Key, Florida, July, 1960. Coll. M. L. Jones.

J. F. Day Collection: Beaufort Shelf transect, off N. Carolina, 34°34'5"N, 76°25'5"W, 20 m., April 19, 1965; 34°19'6"N, 75°56'8"W, 130 m., April 6, 1965.

The paratria of *Smithsonidrillus* are very similar to those of *Bothrioneurum*, in which tubular vasa deferentia and atria covered with diffuse prostate glands enter a median chamber into which these practically solid structures project. There are

no spermathecae in *Bothrioncurum*, the spermatophores being attached externally, and there are coelomocytes, both in contrast to the new genus, which also lacks the glandular covering of the atrium. The prostate cells capping the paratria were overlooked in some descriptions of *Bothrioncurum* species, and were only seen here in the sectioned specimen. It is quite probable that these cells are readily detached from the paratria when these are dissected out of the worm. In the dissection, the efferent ducts did not appear to be associated with the paratria, but in the sections it seemed possible that the ducts became very narrow, running along the wall of the lower half of the paratria to open close to the hollow base of the latter. The paratria showed traces of a central canal in section and dissection, but there was no clear lumen except near the distal end (that opposite to the prostate cells, which is protruded in copulation in all probability). Penial and spermathecal setae were also only seen in the material from North Carolina, but these could easily have been lost in dissecting the single mature specimen from Florida.

There are some superficial similarities between this species and that recently described by Marcus (1965) under the name *Jolydrilus jaulus*. This Brazilian brackish-water species also has a median male pore, but has protrusible pseudo-penes at the end of short tubular atria. It has no spermathecae, and apparently lacks coelomocytes.

It is clear that there are more marine species to be described in this family, usually held to be almost exclusively fresh-water in habit. The small size of many marine oligochaetes in comparison to many other marine invertebrates probably ensures that either they are not obtained by the commoner sampling grabs employed in marine work, or they are overlooked in subsequent sorting.

The discovery of species known formerly from Naples in material from the Atlantic and Gulf Coast of North America further supports the view that many of these oligochaetes are widely distributed. The marine tubificid fauna of the New England states of the U. S. A. has already been shown to be rather similar to that of Europe and the Mediterranean, with certain exceptions, such as *Tubificax costatus*.

I must record my gratitude to Dr. Meredith L. Jones and Dr. John H. Day for the gift of material, and to Mr. C. A. Grainge for sectioning the worms.

SUMMARY

The re-discovery of a tubificid originally described as *Heterodrilus arenicolus*, together with a study of the efferent ducts of *Clitellio arenarius*, has led to the merging of *Heterodrilus* in *Clitellio*. *Clitellio subtilis* seems to be very closely related to *C. arenicolus*. A new genus is erected to receive a second marine species discovered, like the first, in material from the Gulf of Mexico and the Atlantic seaboard off North Carolina, U. S. A.

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